

## METHOD FOR TRANSPORTING SEMI-PROCESSED RUBBER

5           This invention relates to transporting goods, for example rubber, particularly, but not exclusively to transporting goods which can alter their state during transportation to become unusable or such that they require processing after transportation to make the goods usable:

10           Rubber is produced by tapping the latex of the tree *Hevea brasiliensis*. The latex flows into a collection cup from the tapped tree from where it is passed to a pan where it coagulates to form a cake. Water is rolled or pressed from the cake to provide a dewatered cake of fresh rubber which has the consistency of plasticene (RTM).

15           The cake, which may be called semi-processed rubber, is then transported to the end users for further processing such as cleaning and drying in an oven. Further processes may be used to provide rubber having the technical characteristics necessary for, say, vehicle tyre production and to thereby form the rubber into the end product.

20           Originally, the latex was harvested from wild trees in South America, although today over 90% of the world's natural rubber comes from plantations of rubber trees in South East Asia. It is usually classified into one of several classes, TSR (Technically Specified Rubber), sheet rubber (such as RSS - Ribbed Smoked Sheets or ADS – Air Dried Sheets), pale crepe and speciality rubber (oil extended natural rubber,  
25           depolymerised natural rubber and so on).

Most rubber produced today conforms to the TSR scheme and is graded according to the type or kind of rubber (TSR CV, TSR L, TSR 5, TSR 10, TSR20). Further, each major rubber producing country has its own schemes for further  
5 differentiating or subdividing the rubbers of the TSR scheme produced therein (SIR – Standard Indonesian Rubber; SMR – Standard Malaysian Rubber; STR – Standard Thai Rubber; SVR – Standard Vietnamese Rubber). The TSR scheme requires that the rubber is transported in standardised packaging of 33.3 or 35 kg bales (ca. 330 x 670 x 170 mm) wrapped in polyethylene, with thirty six bales on a crated or shrink-wrapped  
10 on a standard pallet to give a crate size of 1260 kg.

RSS rubber consists of deliberately coagulated rubber sheets, completely dried using smoke. In ADS rubber the sheets are dried in the air. The sheets are then graded into three main grades according to their color, consistency and observed impurities.  
15 The purest is 1RSS S/B, then 2RSS S/B then 3RSS S/B. RSS is transported in standard TSR pack (designated S/B for small bales) consisting of a compressed bale of 33.3 or 35 kg or in conventional big bale of 111.11kg. A crate size is about 1200 or 1260 Kilos. RSS are used when extra tough (due to extensive cross linking) rubber is needed. Some applications are tires, tank liners, industrial products, etc. RSS is  
20 generally more difficult to process than TSR.

Pale crepe consists of carefully collected fresh liquid latex, deliberately coagulated and (sometimes) bleached, milled to produce crepe of a thickness corresponding approximately to standardized thickness, either thin or thick. There are a  
25 number of grades available with the purest being 1X Thick Pale Crepe (1XTPC) while the most popular is 1 Thick Pale Crepe (1TPC). 2 Thick Pale Crepe is also available.

Pale Crepe is usually sold in 25 kg bales with 32 bales packed onto a crated pallet of 800kgs, suitable for Ocean Container shipping. Pale Crepe is used in FDA applications, medical sundries, footwear, cements and adhesives, and any application that requires light color, sweet smell and good properties.

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Many end users of natural rubber are located in the United States of America, Japan and Europe. Transportation of rubber, by ship, from South East Asia to Europe or the United States will usually take from one month to six weeks. The temperature in the hold of a ship is typically below 10°C.

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During such transportation, and in such a chilled environment, the rubber cakes cool and harden and crystallisation within the rubber can, and does, occur. The rubber is unusable in that state. This process of crystallisation continues or is compounded when the rubber is stored at the destination port in a cold warehouse or factory, before  
15 being delivered to the end-user.

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Rubber is a known insulator and, therefore, has a low thermal conductivity, *i.e.* it losses and gains heat very slowly. In order to alter the rubber back to its usable state, it is necessary to slowly heat the rubber to about 70 to 180 °C over a period of about three days to three weeks depending on the type of rubber. The heating causes the  
20 rubber to soften and for the crystals to dissolve.

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Clearly, it is inconvenient and expensive for the end user to have to hold a, say, ten-day stock of rubber whilst it is being transformed into a usable form. It is also expensive to complete the transformation. Thus, time and money is wasted in holding  
25 and transforming the stocks, extra warehousing space and energy is also required as

well as capital investment in the plant and personnel required to complete the transformation.

Accordingly, it is an object of this invention to provide a method of transporting  
5 goods such as rubber which will reduce the time and effort required to convert the transported material back into a usable form once it has been delivered.

A first aspect of the invention provides a method of transporting semi-processed rubber, the method comprising locating the semi-processed rubber in a ship and  
10 supplying heat to the semi-processed rubber during transit to prevent solidification of, and/or crystallisation in, the semi-processed rubber.

When referring to solidification, it will be understood that what is meant is even partially hardening or crystallization within the rubber which would result in the rubber  
15 having to be heated at the end of its journey, say by the end-user, to render the semi-processed rubber usable.

Preferably, sufficient heat is supplied to the semi-processed rubber so that it is held at a temperature above 25 °C, most preferably in a range of from 28 to 35 °C, and  
20 even more preferably in a range of from 30 to 33 °C. In fact, the desired temperature is 32 °C, although variations within the above-identified ranges are acceptable.

The heat for heating the semi-processed rubber may come from heat re-circulated from the ship engine. The heat may be provided by a heating blanket placed  
25 over, under, around or otherwise adjacent the semi-processed rubber. A container, in which the semi-processed rubber is located in the ship, may be a heated container.

Heat may be directed from the engine room using the water which is drawn through the engine to cool it. That water may be directed through the ship to where it may flow through pipes or panels to heat the semi-processed rubber. Other waste heat may also be utilised.

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Heat may be directed to a heat exchanger to heat circulating air, the heated air then being circulated into the hold of the ship where the rubber is stored for transport. Alternatively or additionally, convection heaters, for example electrical convection heaters, may be used.

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If a blanket or heated container is used only a low current heating element is required as the requisite temperature is only marginally above ambient. Therefore, the energy required to maintain the rubber in its original, semi-processed state is not excessive.

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The method may further comprise storing the semi-processed rubber in a covered warehouse or storage facility at a destination port, the warehouse preferably being maintained at a temperature sufficient to prevent the rubber from solidifying and/or crystallising during storage.

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The method may further comprise transporting the semi-processed rubber to an end user in a state which is usable without requiring further heating.

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A second aspect of the invention provides a method of supplying semi-processed rubber to an end-user in a usable form, the method comprising tapping latex from a rubber tree, forming a cake, transporting the cake to a local processor for semi-processing and subsequently transporting the semi-processed rubber cake to an end

user and ensuring that the cake does not harden or that crystals form in the cake during the first and/or second transportation step.

A third aspect of the invention provides a method of transporting solid goods  
5 whose state is prone to alter during transportation, the method comprising maintaining the goods at a temperature of from 25 to 35 °C during transportation by supplying heated air to the goods using heat reclaimed from the prime mover of the means of transportation.

10 Preferably, the goods are semi-processed rubber.

Preferably, at least part of said transportation takes place on a ship and said transportation means is a ship.

15 A further aspect of the invention provides a method of supplying semi-processed rubber to a user, the method comprising storing the semi-processed rubber in a location which is maintained at a temperature to prevent or at least inhibit the hardening of, or formation of crystals in, the semi-processed rubber.

20 A yet further aspect of the invention provides an inflatable bag or bladder sized and dimensioned to be located adjacent the wall of a hold of a ship to insulate said wall.

Typically, the bag or bladder will have a thickness, when inflated of from 5 to 50  
25 cm. A plurality of bags may be used to cover the walls of the hold of a ship.

In this specification where reference is made to semi-processed rubber, rubber cakes/bales and the like, it will be understood that what is meant is any form of semi-processed rubber which is liable to change its state (e.g. to harden or crystals to form therein) when transported.

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In order that the invention may be more fully understood, it will now be explained by way of example only and with reference to the accompanying drawings, in which:

10        Figure 1 is a perspective view of a part of a hold of a ship; and  
          Figure 2 is a section along line X-X of Figure 1.

          Referring to the Figures, there is shown a wall 1 of a ship which defines at least part of a hold 2. Located within the hold is a plurality of stacked crates 3, each  
15        containing rubber. Located at the centre of the stack of crates 3 is a heat exchanger 4.

          An insulating material 5 is located adjacent each wall 1 of the hold 2. In Figure 2 the insulating material 5 is an inflatable bladder or bag 6 which is filled with a fluid which is usually a gas and is typically air. The walls of the bladder or bag 6 will typically  
20        be made from a polymer or other material which has a low thermal conductivity. The bladder or bag 6 may be inflated using pumps or using the fan or blower associated with the heat exchanger 4. The bladder or bag 6 may extend over the whole of the hold 2 or there may be several bladders 6 which cover a section of the hold 2.

25        Other insulating materials 5 may be used such as curtains or drapes and the like, the main characteristic being that the insulating material is removable or

collapsible once the goods have been, or before the goods are, removed from the ship's hold 2.

Hot water from the ship's engine, boiler or engine room (not shown) is pumped  
5 to the heat exchanger 4 where it heats air. The heated air is then distributed about the hold 2 using the blower or fan (not shown) which is operatively associated with the heat exchanger 4. The fan or blower draws air into the heat exchanger 4, as indicated by arrows A, and blows the heated air into the hold 2, as indicated by arrows B. In this way the ambient temperature in the hold 2 is maintained at a temperature which will  
10 prevent crystallization in the rubber contained in the crates 3, say above 25°C.

The position of the heat exchanger 4 is not limited to the centre of the hold 2, as shown. Indeed, it may be easier to place the heat exchanger 4 at the side of the hold 2 which would decrease the complexity of piping the hot or heated water to the heat  
15 exchanger 4 and piping the cold or cooled water from the heat exchanger 4. In principle, the heat exchanger 4 will be more efficiently employed if it is at the side of the hold 2 at the closest position to the engine room or other source of heat exchange medium. This may lead to a concomitant reduction in the constancy of the heating of the hold 2 but this may be more than offset by the increase in the ease of loading the  
20 goods, the temperature of the heat exchange medium as supplied to the heat exchanger 4 and the complexity of retro-fitting or fitting the heat exchanger 4 into the hold 2 of a ship.

In use, the rubber, located within the crates 3, will be loaded into the hold 2 in a  
25 conventional manner. The inflatable bladder or bag 6 will be inflated and the heat exchanger 4 will commence operation. The combination of the heat exchanger 4 and the insulating effect provided by the bladder or bag 6 will prevent the rubber within the



crates 3 from experiencing ambient temperatures less than 25 °C, and thereby will prevent crystallization or hardening of the rubber.

The heat exchanger 4 may be replaced with convection heaters or blowers, for example electrical convection heaters or blowers. Alternatively or additionally, the water from the engine room or other heat exchange medium may be pumped through or around the crates (for example, above, below and/or between), the pipes or conduits acting as radiators to maintain the temperature of the rubber.

To heat the rubber any suitable means may be used. A particularly advantageous method requires capturing waste heat from the engine of a ship and re-directing that heat to heat the rubber. In one particular embodiment, the cooling water used to cool the engines is pumped to the hold 2 to act as the heat exchange medium in the heat exchanger 4 to heat the rubber or at least the container in which the rubber is located. Waste heat from the engine exhausts may alternatively or additionally be used.

### **Example 1**

Rubber was tapped from a tree and two cakes were formed, as is well known to the skilled addressee.

The first cake/bale was packed and placed in a shipping container and left for a period of one month at a temperature similar to those found in the holds of ships.

The second cake/bale was placed in an identical container and had a heating blanket placed under and over it. The heating blanket was arranged to keep the rubber at about 32 °C. The heat was supplied for from 14 days to 50 days, to simulate corresponding journeys.

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At the end of the period the cakes/bales were removed from the containers and compared. The first had hardened significantly and there was evidence of crystallisation. It was evident that the rubber would have to be heated to return it to a usable state. The second cake was usable as it was.

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### **Example 2**

Rubber which had been tapped, formed into a cake/bale and semi-processed, and the cake/bale stored at a temperature of 32 °C for a month was removed from its container or break bulk vessel and left in a warehouse for one week, to simulate storage of the cake/bale at a destination port. The warehouse was maintained at an ambient temperature of 24 °C. At the end of the week the rubber cake/bale was examined. The cake was still in a usable condition. Whilst we do not wish to be limited to any particular theory, it is postulated that due to rubber's low thermal conductivity the rubber retains its heat and therefore does not harden even when left at a lower temperature for a week.

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It will be appreciated by the skilled addressee that by ensuring that the rubber cakes/bales are heated to above 25°C, say about 32°C, or maintained at that temperature, rubber may be transported around the world and sent to a user in a

usable condition. This obviates the need for pre-processing (e.g. heating) the rubber before it is used by the end-user, thereby reducing warehouse costs, capital costs associated with pre-processing of the rubber (e.g. heating for a week) and increasing efficiency of the whole operation.

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Other goods may be transported by ship using the same methods.